VGDD
Visual Graphics Display Designer

Lab Project 1

Building a GUI with VGDD

© 2015 VirtualFab
All rights reserved

Version 2.0
2015/07/04

• Index

Introduction....3
Prerequisites....3
Preliminary steps....3
Choosing a Folder....3
Start MPLAB X IDE....4
Install and configure the VGDD-Link plug-in....4
Create an empty MPLAB X project....4
Start the VGDD-Link plug-in....5
Running VGDD the first time – Configure frameworks....5
Setting project properties....6
1 Create a new VGDD project....7
1.1 Saving the screen and creating the project....7
1.2 Adding a Rectangle....7
1.3 Duplicating objects....8
1.4 Adding the top and bottom texts....8
1.5 Creating a new Scheme....9
1.6 Applying new scheme to all StaticTexts....9
1.7 Adding the Temperature display....9
1.8 Creating a Big Font scheme....10
1.9 Defining Widget's Text as RAM buffer....11
1.10 Adding a Picture....11
1.11 Adding Buttons....12
2 Running the GUI on the Development Board....12
2.1 Running the Wizard....12
2.2 Compiling the MPLAB X project and running it on the DevBoard....15
3 Modifying the GUI....15
3.1 Adding a Buttons Menu....15
3.2 Adding button's bitmaps....15
3.3 Copying selected Widgets between screens....16
3.4 Duplicating a Screen....16
4 Designing GUI Navigation: Events Handling....16
4.1 Connecting Screens....16
4.2 Testing GUI navigation by Simulating it on the Player....17
5 GUI development round-trip....18
5.1 Run modified GUI....18
5.2 Hand-Writing Code....18
5.3 Using Events to change variable values....19
6 End of Lab Exercise....19

Introduction.

In this laboratory exercise you will learn how to use VGDD to develop a Graphical User Interface for an example application: a thermostat.

Disclaimer: no real thermostatic function will be implemented. The exercise will focus on GUI development only.

Points covered in this exercise:

- Multiple screens GUI design
- Event Handling
- MPLAB X Wizard
- Hand-made code implementations
- GUI development round-trip

Note: this exercise is based on the use of the PIC24FJ256DA210 Development Board with a Powertip 480x272 WQVGA 4.3” TFT display, but it can be easily adapted for other hardware configurations.

Prerequisites

This exercise needs

1) MPLAB X IDE version 3.0 and above

2) XC16 Compiler version 1.24 and above

3) VGDD version 9.0 and above

4) VGDD-Link MPLAB X plug-in

5) The Lab1Resources.zip contents

VGDD, VGDD-Link and Lab1Resources.zip are all available for download from VirtualFab site.

You can have MPLAB X installed on any supported OS (Windows, Linux, MacOs), while **VGDD needs a Windows PC to run**. This can be a physical PC or a Virtual Machine (VirtualBox, Parallels, etc.).

This document refers to a Windows installation.

Preliminary steps

Choosing a Folder

The Lab Exercise needs a folder to store

- VGDD project
- MPLAB X project
- Bitmaps

So let's choose a location on the drive (may be a network folder as well) and create a Folder for the Exercise called for example **VGDDLab1**.

In this folder you can unzip the Bitmaps you found in the zip for the exercise.

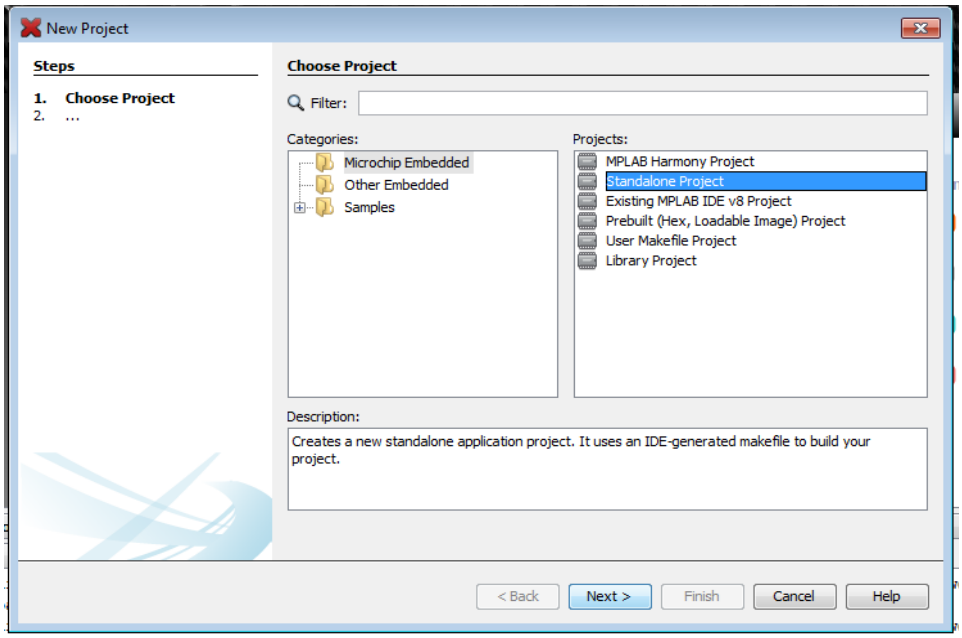
Start MPLAB X IDE

Install and configure the VGDD-Link plug-in

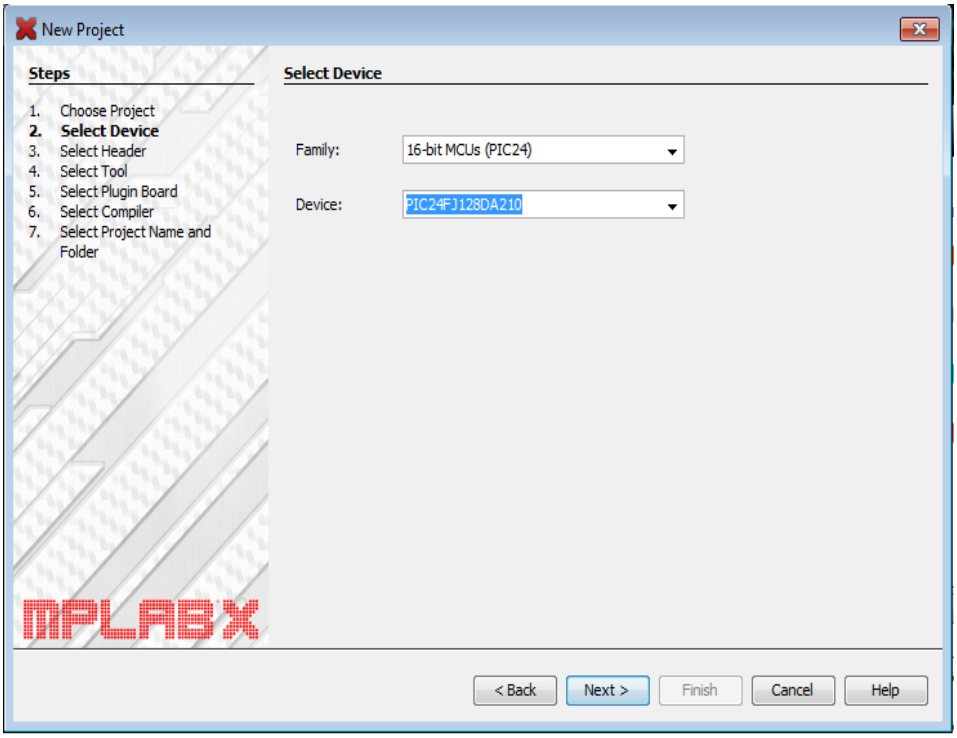
as described in “VGDD-Link plug-in for MPLAB®X User's Manual”.

Create an empty MPLAB X project

Click on the button and proceed with the creation of a Standalone project:



Select PIC24 family and choose PIC24FJ256DA210 device:



Select your PIC programmer tool (RealICE, PicKit3, etc.) and select the compiler to use (XC16).

Give a name to the Project (Thermo1) and as project location, navigate to the folder you created for your exercise.

Notice: using VGDD you are free of placing the MPLAB X project wherever you want.

Once you created the empty MPLAB X project,

Start the VGDD-Link plug-in

by clicking on the button.

This will launch VGDD, which will automatically connect to the running MPLAB X.

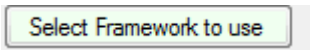
If you instead are working with MPLAB X on a different OS, you'll have to start VGDD manually as described in the VGDD-Link User's manual.

Running VGDD the first time – Configure frameworks

When launched for the first time, VGDD will ask for configuration.

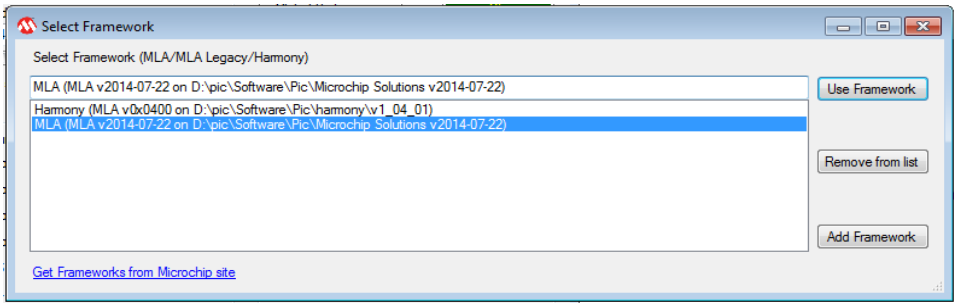
In particular, paths to the frameworks (MLA Legacy, MLA or Harmony) that will be used are to be configured.

You can re-run this phase whenever needed by clicking on the Project Settings toolbar button

and then clicking on the 

button.

This will display the Select Framework panel:

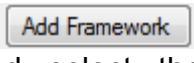

Select Framework
Select Framework (MLA/MLA Legacy/Harmony)
MLA (MLA v2014-07-22 on D:\pic\Software\Pic\Microchip Solutions v2014-07-22)
Harmony (MLA v0x0400 on D:\pic\Software\Pic\harmony\v1_04_01)
MLA (MLA v2014-07-22 on D:\pic\Software\Pic\Microchip Solutions v2014-07-22)
Use Framework
Remove from list
Add Framework
Get Frameworks from Microchip site

This Lab exercise is focused on the PIC24FJ256DA210 Development board, so we will use MLA.

If you don't have MLA yet, you can click on “Get Frameworks from Microchip site” and the browser will open on the right pages.

Download and install “Current MLA”.

At the time of writing, the latest MLA is v2015_05_15.

Once installed MLA, go back to the Select Framework panel, and click on 

, then navigate to the “Doc” subfolder where you installed MLA and select the “module_versions.xml” file. This way the framework will be identified and added to the available Frameworks list.

To use the Framework, click on

Setting project properties

Select the **default screen size** and set it to **480x272**. You can do this also by selecting WQWGA2 from the Quick Settings dropdown.

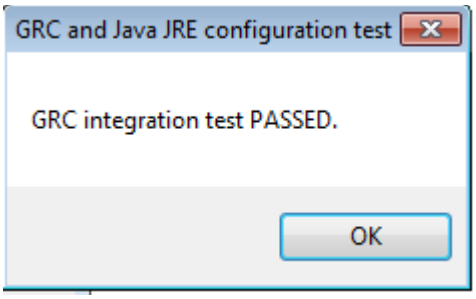
Select the Compiler for your PIC24: **XC16**

GRC is the Graphics Conversion Tool that comes with the selected Framework.

GRC path can be viewed/changed by clicking on the GRC Path button.

Java and GRC integration can be tested by clicking on the Test button.

If you succeeded in running MPLAB X, this means that on your PC Java Runtime Environment is already installed, so the following dialog should appear:



If you instead installed a different runtime (JRE) then you have to change the Java command in “Global Preferences” and repeat this test until it passes.

Notice: On 64-bit PCs, the installed JRE may not be runnable from the command line. In these cases, please download and install also an x86 JRE.

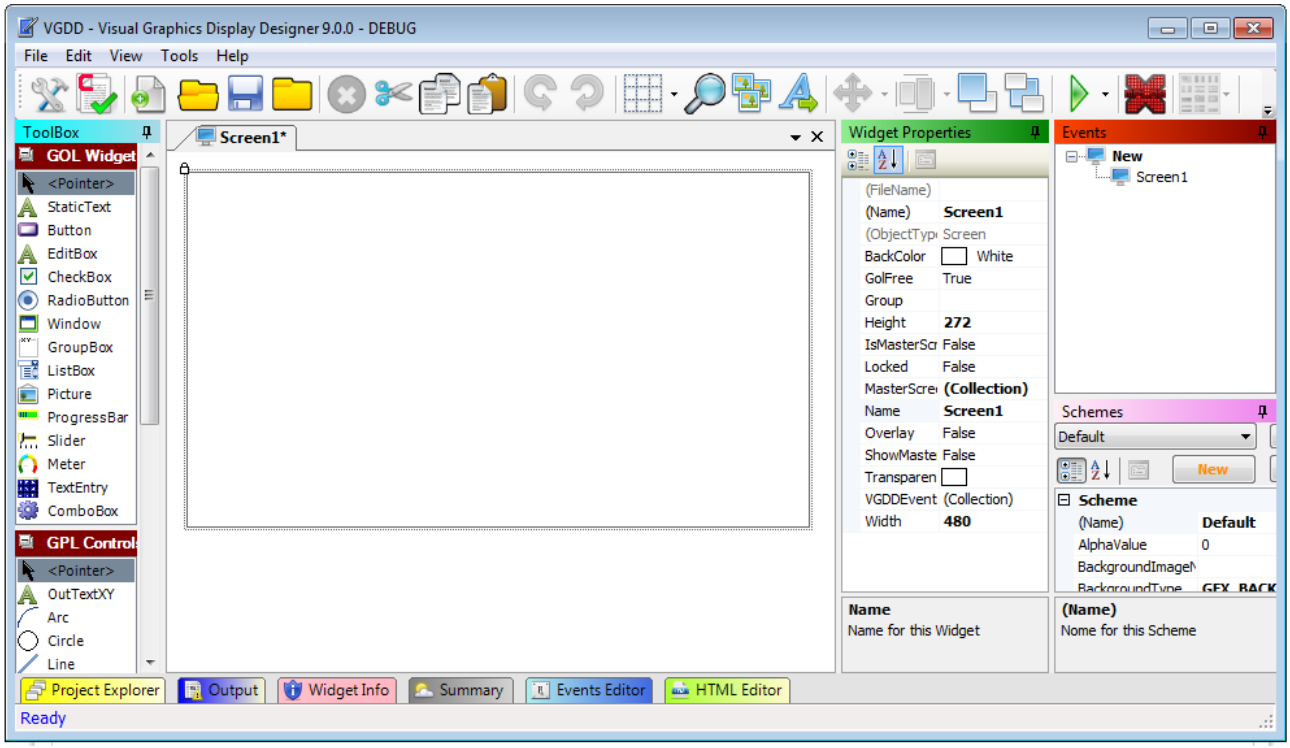
Click on “**OK**” button to save the settings.

1 Create a new VGDD project

Click on “New Project”.

The Project Settings dialog will appear again. Verify that the selected values are those you specified in the previous steps, and confirm with OK.

VGDD will switch to design mode and a new empty Screen will be created:



Change its name to **Main** by going on the Name tab in “Widget Properties”

1.1 Saving the screen and creating the project

Click on the **Save** Toolbar button , navigate to the project folder you created for the exercise, and give a name to this VGDD Project: **Thermo1**

Then VGDD asks for a filename for the **Main** screen. Leave the **Main.vds** default and **save** in the same folder of the project for convenience.

Two different files will be created:

1) Thermo1.vdp containing project settings. In this file screens are saved only by storing their file names.

2) Main.vds containing the screen properties, along with its widgets.

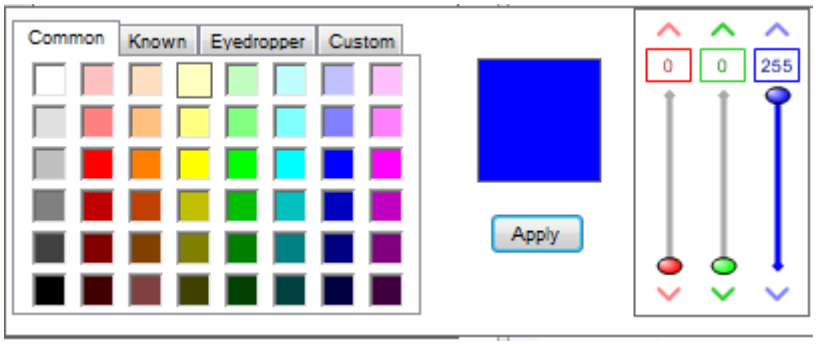
1.2 Adding a Rectangle

Drag a rectangle from the left GPL Toolbox and **drop** it on the screen

Double-click on its “**Fill**” property to make it solid.

Change its colour to Gray by clicking on the button in its colour property:

This will bring up the ColourChooser from which you can select the desired colour.



Resize and place the rectangle on top of the screen by grabbing its design handles.

To precisely place the rectangle, **change its properties** as follows:

Top:0, Left: 0, Height: 25, Width: 480

1.3 Duplicating objects

Copy and paste the rectangle by selecting it and then hitting **CTRL-C** and **CTRL-V** and position it on the screen bottom.

To precisely place the rectangle, you can **move it with the keyboard arrows** until its properties are as follows:

Top:247, Left: 0, Height: 25, Width: 480

1.4 Adding the top and bottom texts

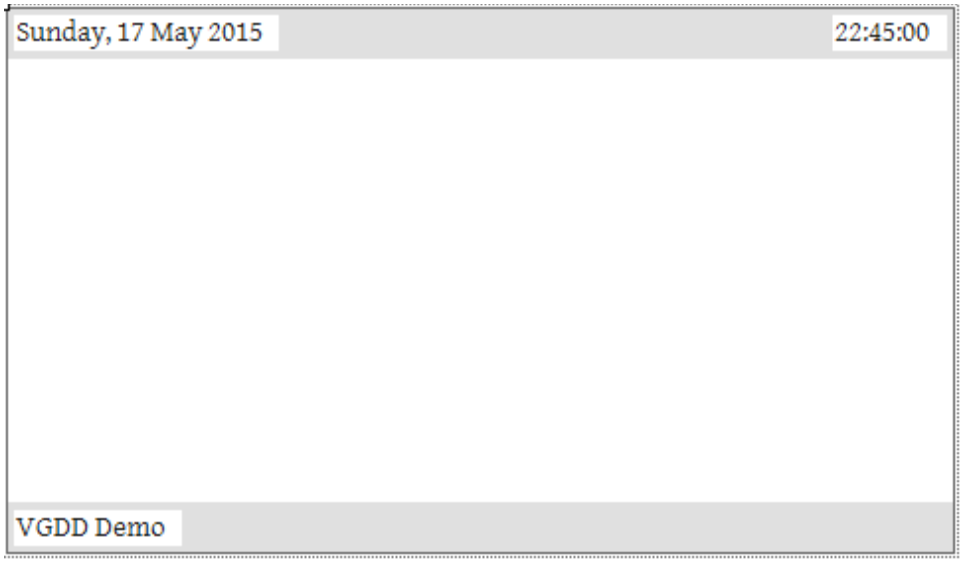
From the **GOL Toolbox**, click on the **StaticText** Widget.

Then **click** on the **screen** on the upper gray band. The new StaticText will be added.

Change its **text** to today's date, long format (i.e. "**Sunday, 17 May 2015**"), then **resize** it for its text to be correctly displayed and finally **finely place** it on the upper band.

Repeat these steps or **Copy&Paste** for the hour StaticText (upper band, right) and for the product name (lower band, left).

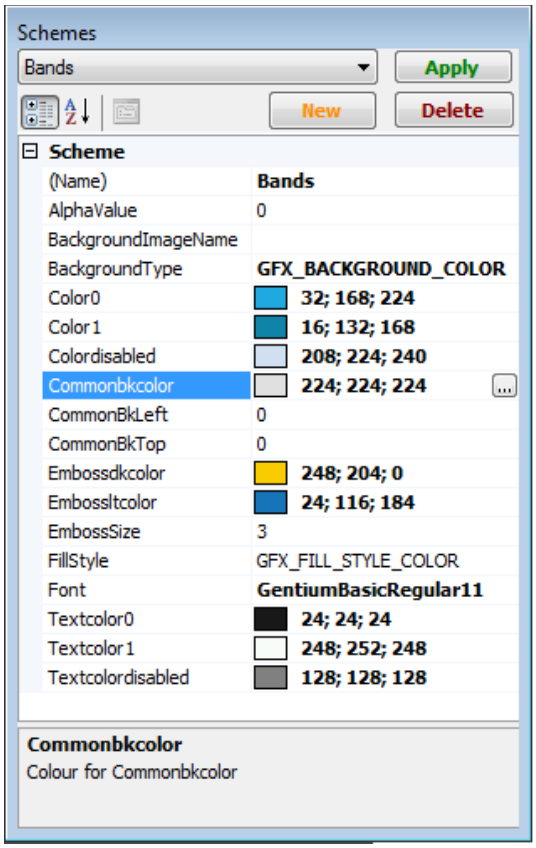
The final result should look like this:



1.5 Creating a new Scheme

To change StaticText background color, a new scheme must be created.

Click on the **New** button in the **Schemes Control**, change its **name** to "**Bands**" and **adjust** colours accordingly (at least **commonbkcolor** to be the same as the bands).

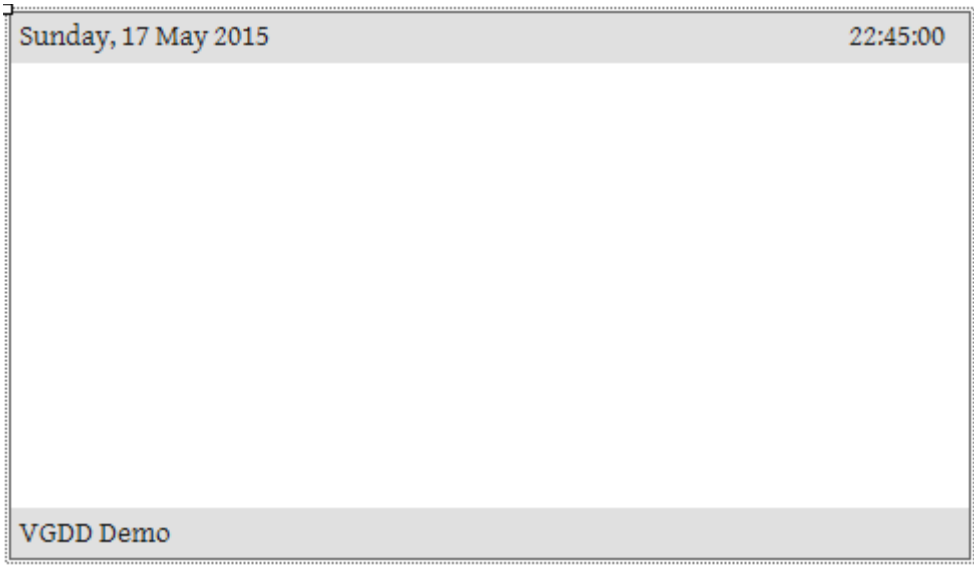


1.6 Applying new scheme to all StaticTexts

Select the three StaticTexts by **clicking** on them while **holding the CTRL key**.

Then go on the **Schemes Control**, verify that the **selected scheme** is the "**Bands**" scheme just created and click on the **Apply** button.

The final result should be like this:



1.7 Adding the Temperature display

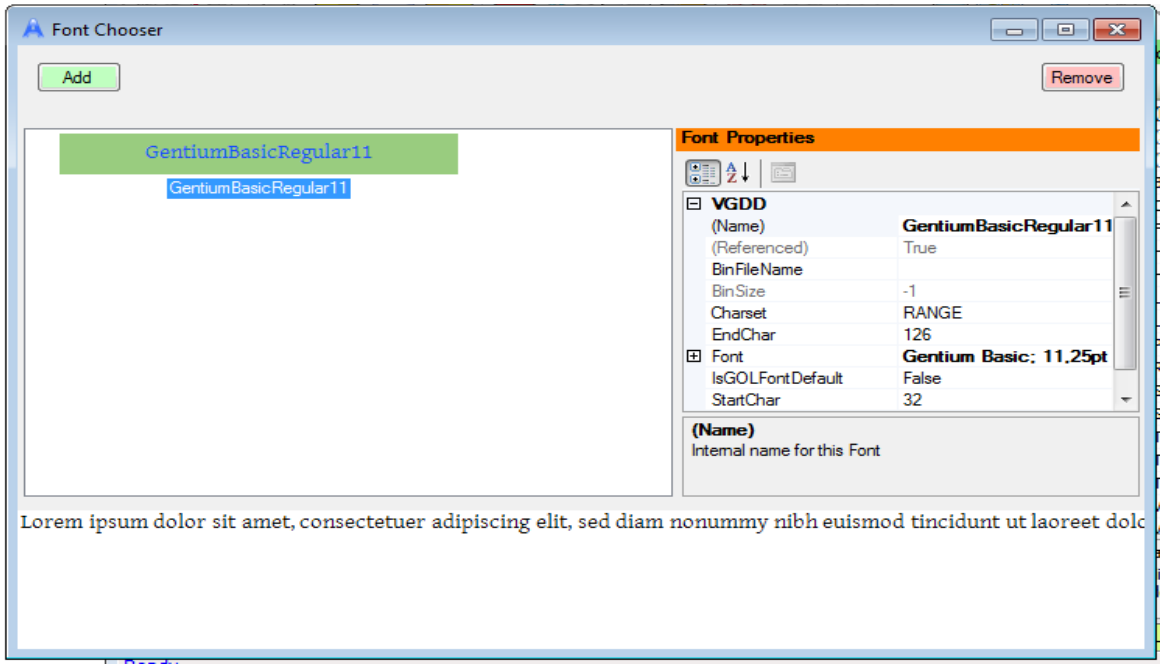
Select the **StaticText** Widget from the ToolBox on the left, go on the screen and **draw a big rectangle**, covering the left-centre part of it.

Give it the name **txtTemperature**

1.8 Creating a Big Font scheme

Go to the **Scheme Control** and click **New**.

Change the scheme's **name** to "**BigFont**" and then go to font selection by clicking on the "**...**" button. This opens up the **Font Chooser**.



Click on the **Add** button, and choose a Gentium 72 points. The new font is added to the sample list on the left.

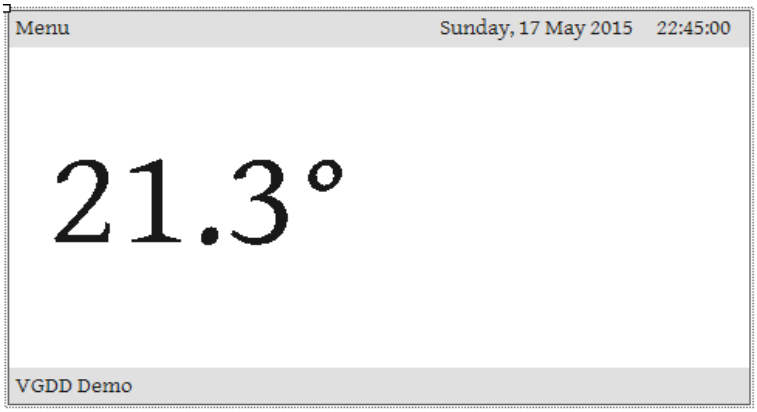
To limit Flash font size, change the **Charset** property from RANGE (default) to **SELECTION**.

We need all the numeric symbols from 0 to 9, the **minus**, the **dot** and the **degree** chars for our temperature, so add to the **CharsIncluded** property the needed characters: **-.0123456789°**

Then **double-click** on the font in the sample list on the left to select and assign it to the newly created scheme.

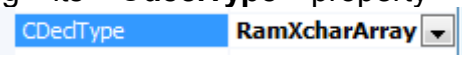
Complete the scheme definition by setting the **commonbgcolor** property to **white**, the same as the screen.

Set the txtTemperature text i.e. to "21.3°", and change its Scheme property to "**BigFont**".



1.9 Defining Widget's Text as RAM buffer

The application needs to change the temperature text so this statictext's text shouldn't be declared as **CONST XCHAR[ ]** but as a normal **XCHAR[ ]**.

This is accomplished by changing its **CdeclType** property from the default ConstXcharArray to **RamXcharArray:** 

1.10 Adding a Picture

Drag and drop a **Picture** Widget and click on its **Bitmap** property. This opens up the **Resource Bitmap Chooser**.

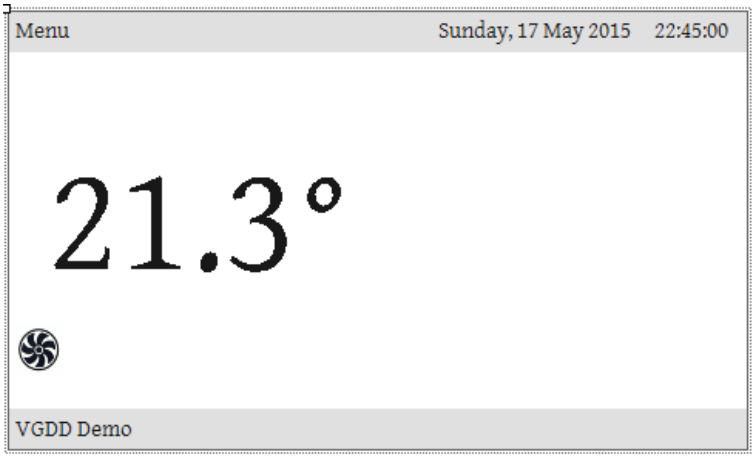
Click on the **Add** button and **select** the **fan3.bmp** bitmap. This adds the bitmap to the available bitmaps set.

Then **double click** on the newly added bitmap to assign it to the Picture Widget, which will be scaled up to fill the default picture size.

Resize the picture to suit your desired appearance style.

Change the name for the Picture to **picFan**.

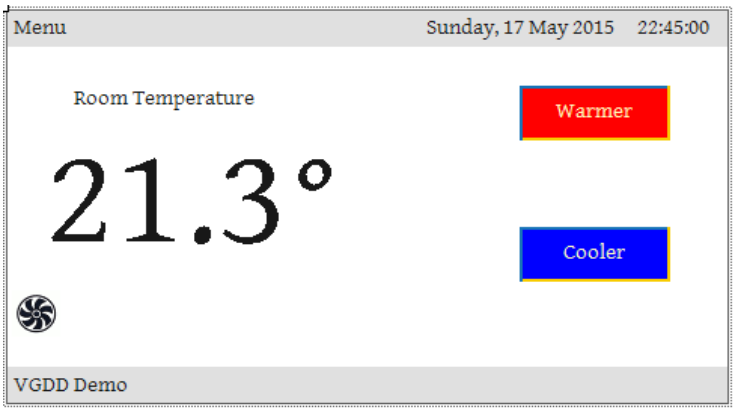
Position the fan bitmap under the txtTemperature.



1.11 Adding Buttons

Add two buttons, named TempUp and TempDown and create their respective schemes to have them in different colours.

Finally add a StaticText label “Room Temperature” to obtain a final result like the following:



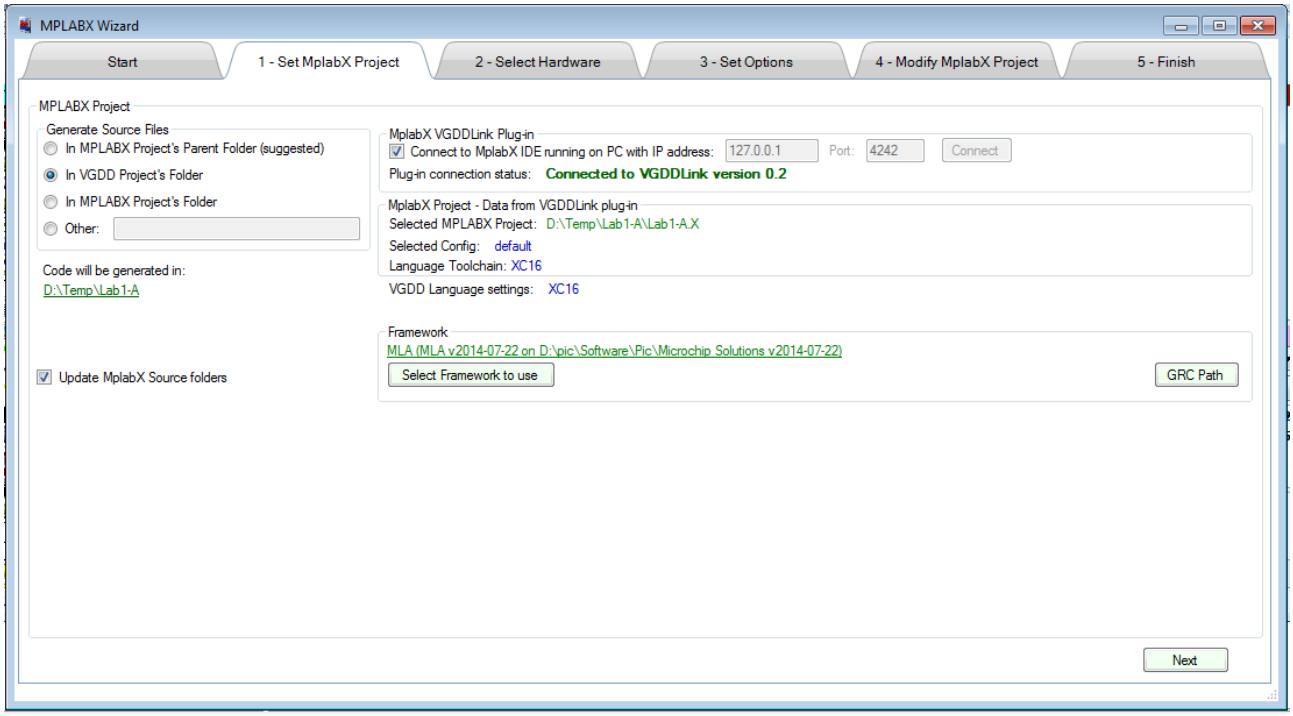
2 Running the GUI on the Development Board

2.1 Running the Wizard

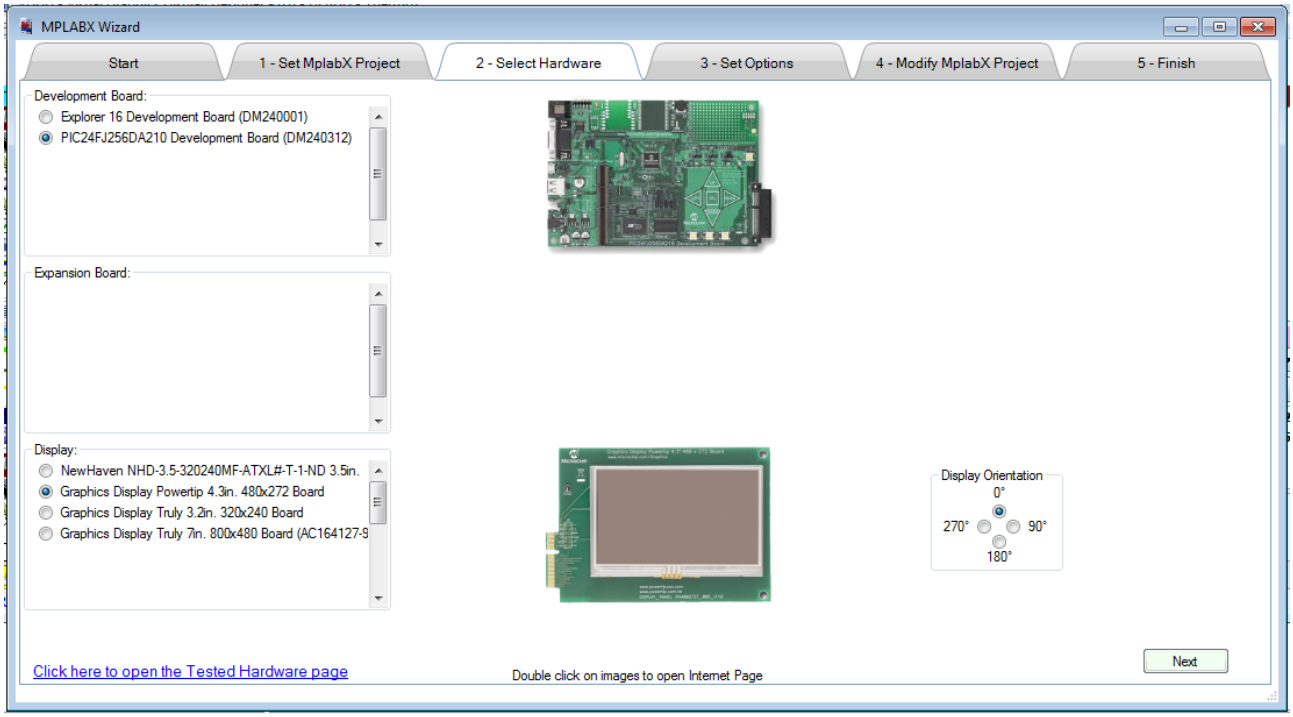
Run the Wizard by clicking on the button on the toolbar.

Go through each Wizard's step:

1-Set MPLAB X project. All data should be already correctly filled in by the plug-in and you shouldn't have anything to modify:

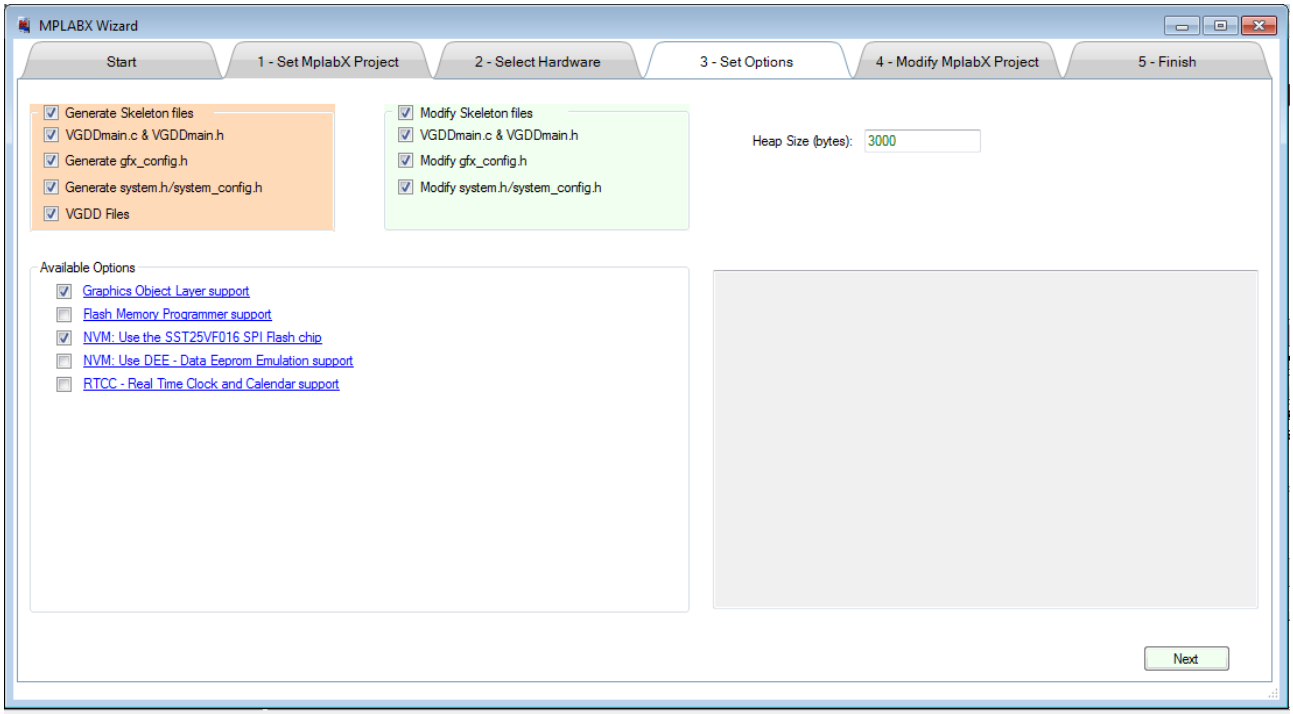

MPLABX Wizard
Start
1 - Set MplabX Project
2 - Select Hardware
3 - Set Options
4 - Modify MplabX Project
5 - Finish
MPLABX Project
Generate Source Files
In MPLABX Project's Parent Folder (suggested)
In VGDD Project's Folder
In MPLABX Project's Folder
Other:
Code will be generated in:
D:\Temp\Lab1-A
Update MplabX Source folders
MplabX VGDDLink Plug-in
Connect to MplabX IDE running on PC with IP address: 127.0.0.1 Port: 4242 Connect
Plug-in connection status: Connected to VGDDLink version 0.2
MplabX Project - Data from VGDDLink plug-in
Selected MPLABX Project: D:\Temp\Lab1-A\Lab1-A.X
Selected Config: default
Language Toolchain: XC16
VGDD Language settings: XC16
Framework
MLA (MLA v2014-07-22 on D:\pic\Software\Pic\Microchip Solutions v2014-07-22)
Select Framework to use
GRC Path
Next

2-Select Hardware: select PIC24FJ256DA210 Development board and the 4.3” Powertip display.

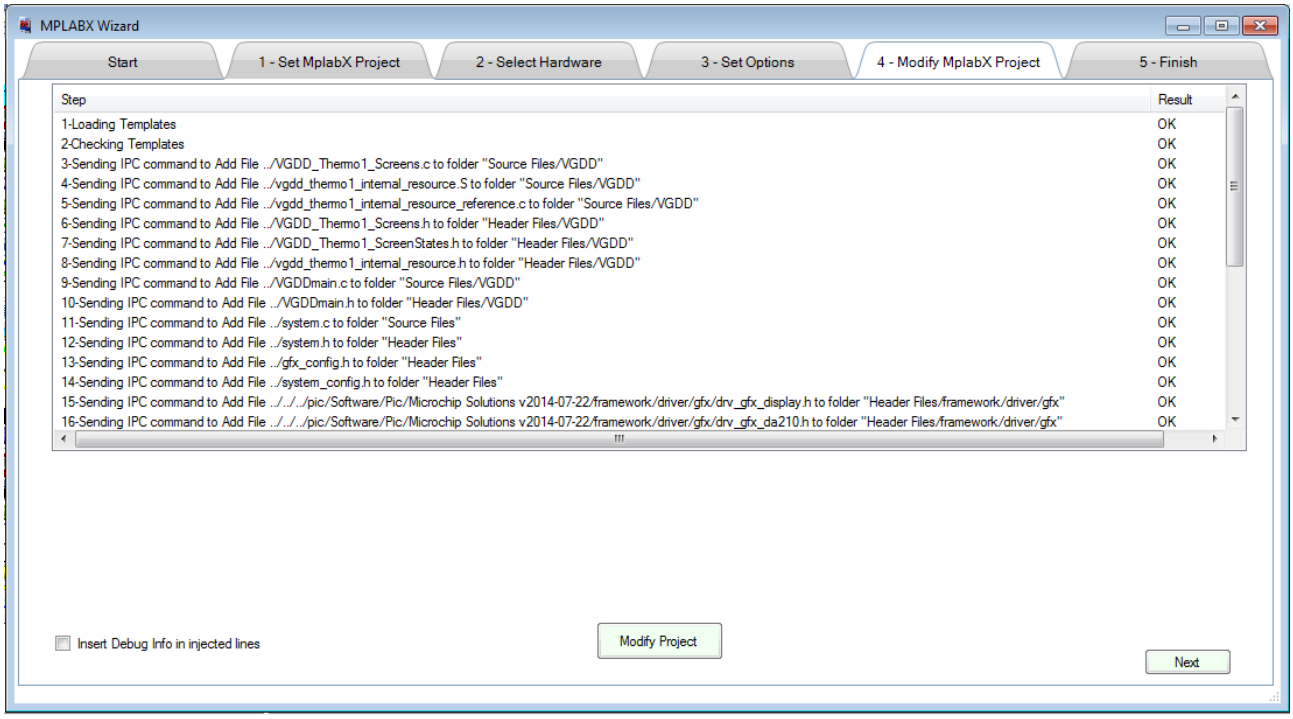


3-Set Options: be sure the “**Graphics Object Layer support**” is checked (this enables GOL support to use the Widgets).

The display driver needs a place where to store calibration data, so check “**NVM: Use SST25VF016 Flash chip**” which is the one provided on the development board:

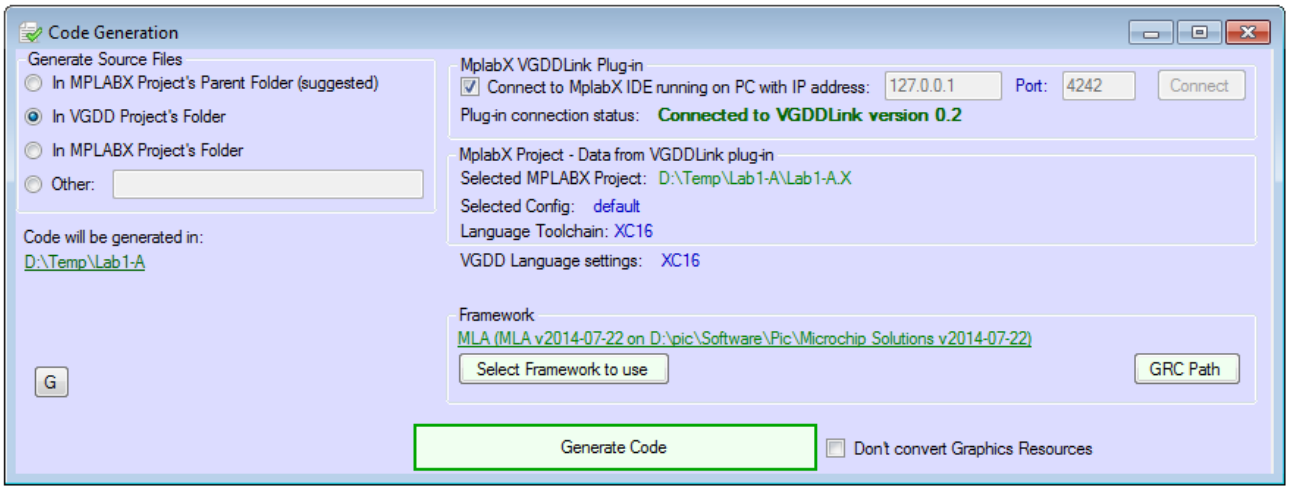


4-Modify MPLAB X Project: simply click on “Modify Project” button. You can switch to MPLAB X to see module files being added in real time by the VGDD-Link plug-in.


MPLABX Wizard
Start
1 - Set MplabX Project
2 - Select Hardware
3 - Set Options
4 - Modify MplabX Project
5 - Finish
Step
Result
1-Loading Templates OK
2-Checking Templates OK
3-Sending IPC command to Add File ../VGDD_Thermo1_Screens.c to folder "Source Files/VGDD" OK
4-Sending IPC command to Add File ../vgdd_thermo1_internal_resource.S to folder "Source Files/VGDD" OK
5-Sending IPC command to Add File ../vgdd_thermo1_internal_resource_reference.c to folder "Source Files/VGDD" OK
6-Sending IPC command to Add File ../VGDD_Thermo1_Screens.h to folder "Header Files/VGDD" OK
7-Sending IPC command to Add File ../VGDD_Thermo1_ScreenStates.h to folder "Header Files/VGDD" OK
8-Sending IPC command to Add File ../vgdd_thermo1_internal_resource.h to folder "Header Files/VGDD" OK
9-Sending IPC command to Add File ../VGDDmain.c to folder "Source Files/VGDD" OK
10-Sending IPC command to Add File ../VGDDmain.h to folder "Header Files/VGDD" OK
11-Sending IPC command to Add File ../system.c to folder "Source Files" OK
12-Sending IPC command to Add File ../system.h to folder "Header Files" OK
13-Sending IPC command to Add File ../gfx_config.h to folder "Header Files" OK
14-Sending IPC command to Add File ../system_config.h to folder "Header Files" OK
15-Sending IPC command to Add File ../../../pic/Software/Pic/Microchip Solutions v2014-07-22/framework/driver/gfx/drv_gfx_display.h to folder "Header Files/framework/driver/gfx" OK
16-Sending IPC command to Add File ../../../pic/Software/Pic/Microchip Solutions v2014-07-22/framework/driver/gfx/drv_gfx_da210.h to folder "Header Files/framework/driver/gfx" OK
Insert Debug Info in injected lines
Modify Project
Next

5-Finish: on the last tab, for your convenience, there's a last button to click: “Generate Code”, which is completely equivalent to the one in the toolbar.

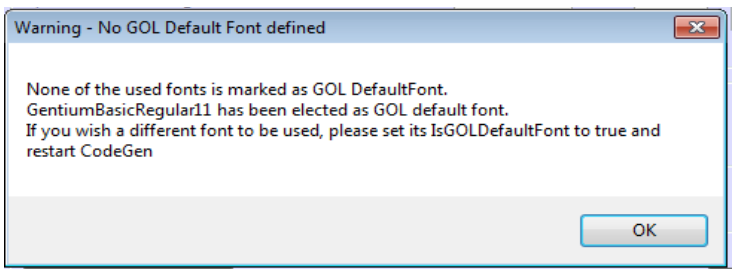
The Generate Code panel will be displayed:



Here you can revise the options, and finally click on “Generate Code”.

Again, a lot of modules will be added to the MPLAB X project through the VGDD-Link plug-in, at least one for each Widget used in your project.

GOL needs a default font to be declared, so the first time you generate the code, a warning will be displayed:


Warning - No GOL Default Font defined
None of the used fonts is marked as GOL DefaultFont.
GentiumBasicRegular11 has been elected as GOL default font.
If you wish a different font to be used, please set its IsGOLDefaultFont to true and restart CodeGen
OK

2.2 Compiling the MPLAB X project and running it on the DevBoard

Switch to MPLAB X, and click on the **Run Project** button.

The project should correctly compile and the connected board get flashed with the firmware.

The screen you designed on PC will appear on the display.

You will notice that buttons are clickable but nothing happens. We have to add some actions to them.

Let's modify the basic GUI we just created.

3 Modifying the GUI

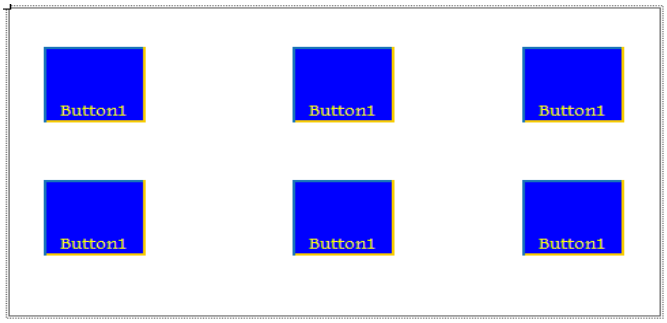
3.1 Adding a Buttons Menu

Go back to VGDD, close the Wizard if you still haven't do so, and click on the Add Screen button to **add a second screen**. Name it "**Menu**"

Add a button, set its **VertAlign** property to **bottom** and its **scheme** to a **new Scheme** named "**Buttons**". Choose the desired colours for the button (face is color0).

Then **copy&paste** the button and replicate it in order to obtain a three-buttons menu row. Center the buttons on the screen.

Then select all three buttons by surrounding them with the mouse and **duplicate** the row with **copy&paste**. Align the second row under the first one to obtain the following result:

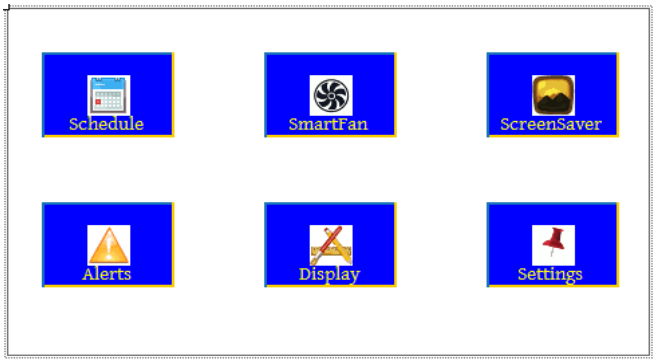


3.2 Adding button's bitmaps

One after the other, edit the **Bitmap** property of each button and add an icon (see step 1.10 on page 11).

Be sure to set each bitmap's **AllowScaling** to **false**, otherwise they will completely fill the buttons' faces.

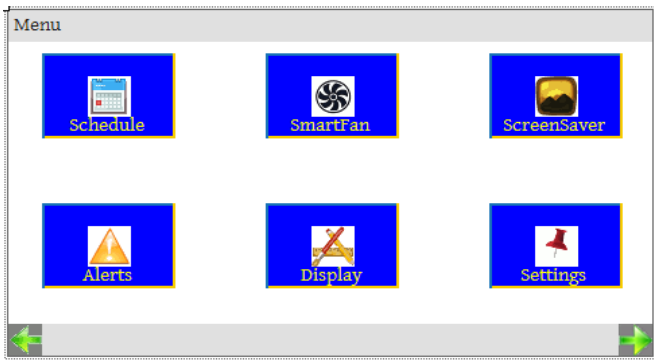
When setting button's bitmap for the first time with a bitmap whose AllowScaling is set to false, the button itself get resized to the bitmap's original size. For this reason you'll have to manually resize the button back to the desired dimensions.



Finally, change button's **Texts** to obtain a result like the one up above.

3.3 Copying selected Widgets between screens

Go to the **main screen** and select upper band, lower band and the date StaticText by clicking them while **holding the CTRL** key. Then Copy them with **CTRL-C**

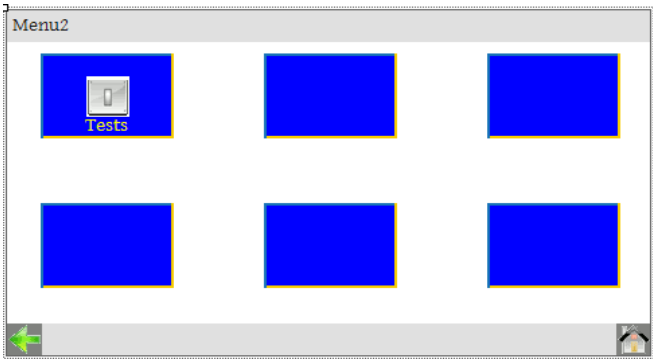


Go back to Menu screen and paste the three objects. Change the Date **text** to "**Menu**" and shrink its width.

Add two arrow pictures on the bottom band for navigation.

3.4 Duplicating a Screen

Select all Widgets on current Screen with **CTRL-A** and copy them to clipboard with **CTRL-C**.



Then **add a new Screen** to the Project, name it "**Menu2**" and paste the Widgets in it with **CTRL-V**.

Change the band title to "**Menu 2**" and button Texts and Bitmaps with new descriptions and icons.

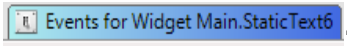
Complete this sample GUI by replacing the lower band right arrow bitmap with a Home one.

4 Designing GUI Navigation: Events Handling

Now that we have a Multi-Screen GUI we have to build the navigation logic between Screens

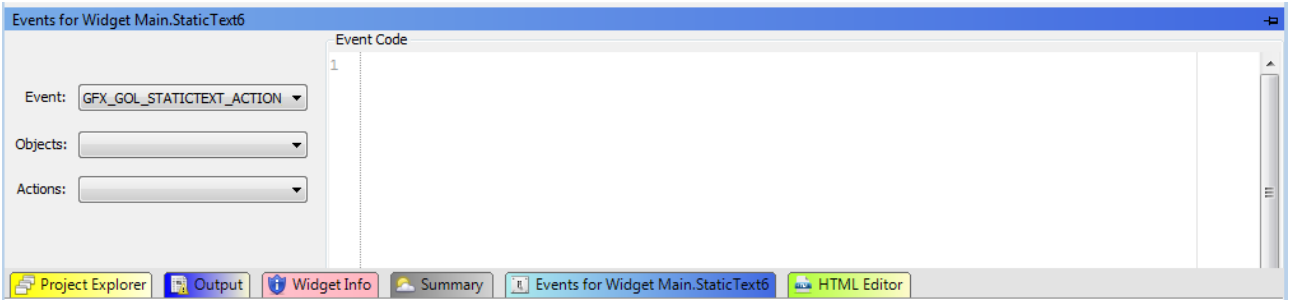
4.1 Connecting Screens

Go on the **Main** Screen and select the **Menu** StaticText.

Click on the **Event tab** 

.

This will display the **Event Editor window.**



Since you are going to make several event handling, it's convenient to pin it by clicking on the button in the upper right corner of the window.

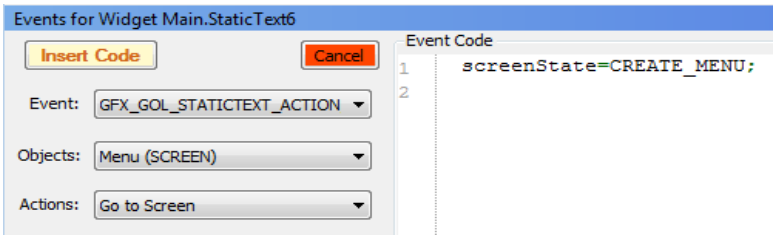
The only available event for the StaticText (**GFX_GOL_STATICTEXT_ACTION**) is already selected in the Event dropdown.

In the **Objects** dropdown select the **Menu (SCREEN)** object.

In the **Actions** dropdown select the **Go To Screen** action.

Then click on **Insert Code** button. This will insert a

```
screenState=CREATE_MENU;
```



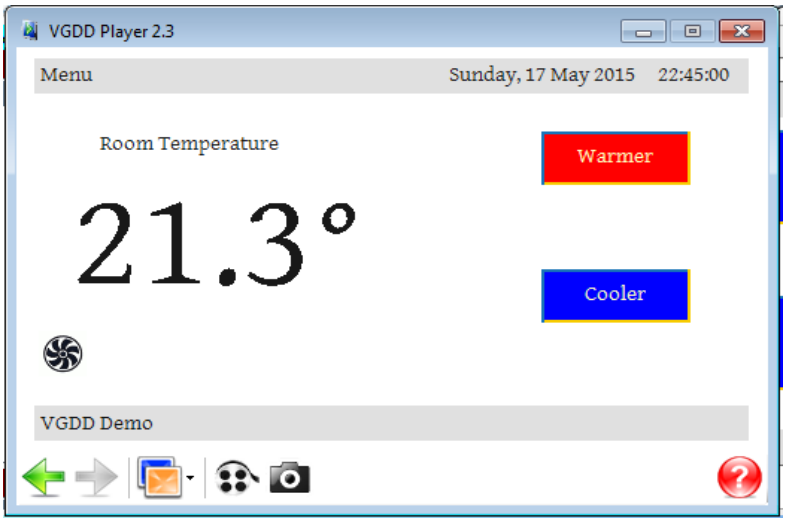
Repeat these steps on the **Menu** screen for both the **left** and **right** arrows in the bottom band, to go back to **Main** screen and to go to **Menu2** screen respectively.

Then go to **Menu2** screen and repeat the same steps to go to **Menu** when the **left** arrow is pressed and to go to **Main** screen when the **Home** icon is pressed.

4.2 Testing GUI navigation by Simulating it on the Player

Click on the **Play Now** toolbar button

This will bring up the **Player** where you can verify by clicking on the GUI than screens are displayed in the correct sequence.



5 GUI development round-trip

5.1 Run modified GUI

At any moment during the development of the GUI you can click the **Generate Code** toolbar button .

In the Code Generation Window the “Don't Convert Graphics Resources” checkbox will be checked only if you haven't done any addition/modification to the resources used in your project. This will skip the GRC phase, reducing development time.

You can now **switch to MPLAB X** and **Run** the modified GUI on the hardware.

5.2 Hand-Writing Code

Let's add the code needed to read the DevBoard potentiometer and display it as Temperature.

Switch to MPLAB X and open the **VGDDmain.c** source file. Near line 134 locate the comment

```
// Application "background" code goes here
```

and **insert the following code** below it:

```
uint16_t potVal, OldPotVal;
uint32_t tickPot;
if (tick - tickPot > 259) {
    tickPot = tick;
#if defined(ADC_POT)
    potVal = TempOffset + (adcPot >> 1);
#else
    potVal = TempOffset;
#endif
    if (potVal != OldPotVal) {
        OldPotVal = potVal;
        Main_txtTemperature_Text[3] = potVal % 10 + 0x23;
        potVal /= 10;
        Main_txtTemperature_Text[1] = potVal % 10 + 0x23;
        potVal /= 10;
        Main_txtTemperature_Text[0] = potVal % 10 + 0x23;
        potVal /= 10;
        GFX_GOL_ObjectStateSet(GFX_GOL_ObjectFind(ID_Main_txtTemperature), GFX_GOL_STATICTEXT_DRAW_STATE);
        if (OldPotVal > 200) {
            GFX_GOL_ObjectStateClear(GFX_GOL_ObjectFind(ID_Main_picFan), GFX_GOL_PICTURECONTROL_HIDE_STATE);
        } else {
            GFX_GOL_ObjectStateSet(GFX_GOL_ObjectFind(ID_Main_picFan), GFX_GOL_PICTURECONTROL_HIDE_STATE);
        }
        GFX_GOL_ObjectStateSet(GFX_GOL_ObjectFind(ID_Main_picFan), GFX_GOL_PICTURECONTROL_DRAW_STATE);
    }
}
```

Then go up and locate the

```
//                          GLOBAL VARIABLES FOR APPLICATION
```

near line 93 and **insert the following declaration**:

```
uint8_t TempOffset = 0;
```

Last thing to do is to **make** the TempOffset variable ***visible*** to the VGDD events code:

Open the **VGDDmain.h** header file and at the bottom locate the

```
volatile extern SCREEN_STATES screenState;
```

and **insert** the following **extern declarations** below it:

```
extern uint8_t TempOffset;
extern volatile int16_t adcPot;
```

Building and running the project now will display a simulated Temperature value which can be modified via the potentiometer. Playing around the 20.0° threshold will turn on/off the fan icon.

5.3 Using Events to change variable values

Go back to VGDD and, on the **Main** screen, select the **Warmer** button.

Open the Event Editor, in the Events dropdown select the **GFX_GOL_BUTTON_ACTION_RELEASE** event and **add the following code**:

```
TempOffset++;
```

Do the same with the **Cooler** button, but with the following line of code:

```
TempOffset--;
```

Now **Generate Code** as usual, **switch to MPLAB X** and **run** the project: the temperature can now be adjusted both with the potentiometer (where applicable) and by touching the two buttons, up and down by 0.1°.

6 End of Lab Exercise

Thank you!